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# RREARING AND GRAINAGE BEHAVIOUR OF DIFFERENT GERMPLASM ACCESSIONS OF MUGA SILKWORM, ANTHERAEA ASSAMENSIS HELFER, IN ASSAM (INDIA)

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**Abstract :-** Muga silkworm, *Antheraea assamensis*, Helfer., is the producer of Golden Muga silk and is indigenous to the Brahmaputra valley of Assam. Seven accessions of Muga silkworm, *Antheraea assamensis*, Helfer., were collected from different Muga growing areas of Assam and bordering areas, and assigned with accession numbers (AC-1 to AC7). Rearing and grainage performance were studied under natural conditions for 2 years and analysed. Wide range of variability was observed among the populations in terms of rearing and grainage performance. AC-4 was considered as the best performer in both rearing and grainage performance with larval weight 14.5g, ERR 63.5%, Cocoon weight 4.89g in male and 7.26g in female, Shell weight 0.67g, Fecundity 162 nos.. AC-2, AC-5, and AC-7 also exhibited superiority in rearing and grainage performance, which may be utilized for yield of hybrids.

**Key Words:-** *Accessions, grainage performance, morphological characterization, rearing performance.*

## INTRODUCTION

The North-East India has been recognized as the centre of Seri-biodiversity in India. The Muga silkworm *Antheraea assamensis*, Helfer. (Phylum-Arthropoda, Class-Insecta, Order- Lepidoptera and Family- Saturniidae) is a multivoltine, polyphagous, semi -domesticated sericigenous insect which produces the golden yellow Muga silk. The silkworm is largely reared in the Brahmaputra valley of Assam (India). Muga silkworm and its host plants are indigenous to North East India (Chaudhury,1981).There was sporadic mention about the occurrence of variants in the natural population of this insect by the works of Chaudhury (1981). Muga culture is practiced on Som *(Persea bombycina)* and Soalu *(Litsea monopetela)* plants. Generally six crops are undertaken in a year. Out of the six there are two commercial crops (Jethua, Kotia), two pre-seed crops (Jarua, Aherua) and two seed crops (Chatua, Bhodia). The abiotic and biotic factors of the environment during different seasons greatly influence the growth and development of Muga silkworm in the form of cocoon weight, pupa weight, shell percentage, fecundity, reelability and denier of the silk (Choudhury, 2003).

Muga silkworms are reared outdoors and are exposed to adverse environmental calamities like high humidity, high temperature, rainfall etc. and leads to heavy loss. Still there is some percentage of survivality in the silkworm populations indicating some variability within and between populations being reared in different areas. Despite tremendous potentialities for healthy growth and development of Muga silk industry through innovation and modernization, a declining trend of this unique industry is clearly manifested over the years. There are valid reasons for this state of affairs. One of the reasons is that Muga silkworm is losing its hybrid vigour and resistance against pests and diseases due to continuous inbreeding depression. Hybridization programme for evaluation of an

improved hybrid strain of Muga silkworm with desired characters is yet to be initiated. Muga culture is practiced by the rural folk of NE region in different localities, and there may be variability on morphological, biochemical, physiological, anatomical and genetic parameters of the silkworm populations spreading over the NE states of India. The present study was made to collect the silkworm populations from different parts of Assam and bordering regions with the prime objectives of conserving the valuable genetic resources and their evaluation for future breeding programme. This paper deals with the rearing and grainage performance of the cultivated Muga silkworm accessions and their evaluation during different seasons.

**Materials and methods**

Seven stocks of Muga silkworms were collected from different prominent Muga growing areas of Assam and bordering regions viz: Mangaldoi, Boko, Tura, Lakhimpur, Goalpara, Jorhat and Kaliapani and were assigned with accession numbers (AC-1 to AC-7). Cocoons were collected from these sites and were brought to the Laboratory (Dept. Of Zoology, Gauhati University, Guwahati, Assam), the dfls (disease free layings) are prepared using standard procedures and with utmost care. 5 dfls for each accession was prepared and kept for hatching. Considering the preference of food plant, the newly hatched worms were reared on Som plantations in the experimental field of the Department. Standard procedures (Chakravorty et al., 2004) were followed for rearing of silkworms and maintaining the host plants. The stocks were maintained separately and continuosly for 2 years (2008-2010). Twelve generations of rearings of each of the silkworm accessions were conducted i.e, 6 rearing seasons per year for 2 years. The 6 Seasons are viz. Season-1 (October-November), Season-2 (December-January), Season-3 (February-March), Season-4 (April-May), Season-5 (June-July), Season-6 (August-September). Morphological study of various stages of the life cycle was done. Rearing and Grainage parameters for all the seven accessions were recorded in all the seasons along with the meteorological data. Mortality of worms due to diseases viz., Flacherie, Grasserie and Muscardine was also recorded. The data obtained for two years were statistically analyzed to determine the significance of the stock for different rearing and grainage parameters. The accessions were then ranked as suggested by Arunachalam and Bandyopadhyay (1984), where a lower value is considered for a desirable character and a higher value for undesirable one.

**Results and Discussions**

Variations in the morphological characters of Muga silworm larva, cocoon, pupa and moth are presented in Table 1a to 1d. Variations in the accessions for rearing and grainage parameters are presented in Table 2a & 2b. Effect of rearing seasons on the rearing and grainage parameters are presented in Table 3. Little variations in the qualitative characters among the accessions were seen, while significant differences were observed in the quantitative characters.

**Table 1a: Larval characters of different Muga silkworm accessions:**

| Accession | Length Of Larva (mm) | Breadth Of Larva (mm) | Weight of Larva (g) |
|---|---|---|---|
| AC-1 | 7.3-85.9 | 1.39-15.33 | 8.2-13.5 |
| AC-2 | 7.2-85.8 | 1.3-15.9 | 9.3-13.8 |
| AC-3 | 6.5-78.5 | 1.25-15.8 | 9.5-13.6 |
| AC-4 | 7.8-88.6 | 1.41-16.5 | 9.5-14.5 |
| AC-5 | 7.0-87.3 | 1.5-16.0 | 9.4-14.0 |
| AC-6 | 7.0-75.9 | 1.5-15.7 | 8.1-12.5 |
| AC-7 | 7.2-86.6 | 1.5-16.1 | 8.7-12.7 |

**Table 1b. Cocoon characters of different Muga silkworm accessions:**

| Accession No. | L:W ratio (cm) | | Peduncle length (cm) | | Dry Cocoon Weight (g) | | Dry shell weight (g) | |
|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F |
| AC-1 | 4.2:1.8 | 5.1:2.1 | 2.9 | 3.0 | 2.105 | 2.398 | 0.332 | 0.467 |
| AC-2 | 4.7:1.9 | 5.1:2.3 | 4.6 | 4.6 | 1.355 | 2.413 | 0.342 | 0.483 |
| AC-3 | 4.5:2.1 | 5.4:2.5 | 3.0 | 3.1 | 1.568 | 2.930 | 0.350 | 0.492 |
| AC-4 | 4.8:2.2 | 5.4:2.8 | 4.6 | 4.7 | 4.890 | 7.260 | 0.670 | 0.551 |
| AC-5 | 4.3:2.0 | 5.3:2.1 | 3.6 | 3.5 | 1.756 | 3.124 | 0.352 | 0.531 |
| AC-6 | 4.2:1.9 | 5.4:2.2 | 3.9 | 4.0 | 1.356 | 2.135 | 0.353 | 0.499 |
| AC-7 | 4.3:1.6 | 5.3:2.3 | 2.8 | 2.9 | 1.322 | 2.568 | 0.441 | 0.537 |

**Table 1c. Pupal characters of different Muga silkworm accessions:**

| Accession No. | Length (cm) | | Breadth (cm) | | Pupal Weight (gm) | |
|---|---|---|---|---|---|---|
| | M | F | M | F | M | F |
| AC-1 | 3.6 | 4.5 | 1.8 | 1.7 | 4.2 | 5.8 |
| AC-2 | 3.7 | 4.6 | 1.5 | 2.0 | 4.8 | 6.5 |
| AC-3 | 3.75 | 4.0 | 1.6 | 1.8 | 4.6 | 5.2 |
| AC-4 | 3.8 | 4.7 | 1.9 | 2.1 | 5.7 | 7.1 |
| AC-5 | 2.9 | 3.9 | 1.5 | 2.0 | 4.9 | 7.0 |
| AC-6 | 3.3 | 4.5 | 1.6 | 1.9 | 4.4 | 5.9 |
| AC-7 | 3.7 | 4.1 | 1.7 | 1.8 | 4.6 | 6.3 |

**Table 1d. Study of Moth characters of different Muga silkworm accessions:**

**Table 1d. Study of Moth characters of different Muga silkworm accessions:**

| Moth Characters | Accessions | | | | | | |
|---|---|---|---|---|---|---|---|
| | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | AC-6 | AC-7 |
| Body colour | Reddish Brown | Brown | Dark Brown | Reddish Brown | Brown | Brown | Brown |
| Body Length (cm) | 2.9-3.5 | 3.1-3.9 | 3.1-3.6 | 3.2-3.8 | 3.0-3.7 | 2.8-3.5 | 2.7-3.5 |
| Wing span (cm) | 13.5 | 15.7 | 15.3 | 15.4 | 15.1 | 14.8 | 15.3 |
| Ground colour of remigium | Shining Brown | Shining Brown | Shining Brown | Shining Brown | Shining Brown | Shining Brown | Shining Brown |
| Colour of Ocellus | Black, white and Yellow | Black, white and Yellow | Black, white and Yellow | Black, white and Yellow | Black, white and Yellow | Black, white and Yellow | Black, white and Yellow |
| Shape of hyaline spot | oval | oval | oval | oval | oval | oval | oval |
| Alignment of A1 &A2 with MC | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight | A1&A2 does not touch MC MC straight |
| Moth weight (g) | 1.326-3.528 | 2.135-3.575 | 2.002-3.159 | 2.101-3.404 | 1.843-3.006 | 2.012-3.423 | 1,951-3.320 |

**Table 2a. Study of ERR, Mortality of worms, Larval Body Weight, Cocoon weight, Shell weight, SR% and Fecundity of different Muga Silkworm accessions .**

| Accession | ERR | Mortality of worms (%) | | | Larval Body weight (g) | | | Cocoon weight (g) | Shell weight (g) | SR % | Fecundity (nos.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grasserie | Flacherie | Muscardine | Male | Female | Average | | | | |
| AC-1 | 57.56b | 13.95f | 14.18bcd | 3.67c | 9.12abc | 11.23d | 10.17d | 4.98c | 0.49d | 10.08bc | 138.55de |
| AC-2 | 56.93c | 15.18cde | 13.50de | 4.54b | 8.95b | 11.63c | 10.29cd | 7.21a | 0.65ab | 9.66d | 160.32b |
| AC-3 | 54.76d | 13.81ef | 15.37a | 5.36a | 8.96bc | 11.70c | 10.33cd | 5.44bc | 0.58b | 9.90cd | 135.05e |
| AC-4 | 63.53a | 8.21h | 8.47f | 2.37d | 9.64a | 14.52b | 12.08a | 7.26a | 0.67a | 11.73a | 162.00a |
| AC-5 | 49.94f | 17.45a | 14.65abc | 4.45b | 8.85bc | 13.39a | 11.12b | 5.85b | 0.55bc | 10.53b | 157.53c |
| AC-6 | 50.27e | 15.91def | 15.25ab | 4.30bc | 8.67d | 11.81c | 10.24cd | 4.60c | 0.56bc | 9.66d | 133.49f |
| AC-7 | 55.56cd | 16.05bcd | 13.95cde | 4.06c | 9.15ab | 11.79c | 10.47c | 5.16bc | 0.51c | 8.95e | 142.72cd |
| S.Ed± | 0.76 | 0.55 | 0.47 | 0.36 | 0.15 | 0.17 | 0.15 | 0.10 | 0.03 | 0.25 | 0.75 |
| CD0.05 | 1.55 | 1.03 | 0.95 | 0.63 | 0.30 | 0.35 | 0.27 | 0.23 | 0.05 | 0.47 | 0.90 |

A figure with common alphabet does not differ significantly

**Table 2b. Effect of different seasons on ERR (%), Mortality of worms(%), Larval weight(gm), Cocoon weight(gm), Shell weight(gm), SR% and Fecundity(Nos.)**

| Season | ERR (%) | Mortality of worms (%) | | | Larval Body weight (gm) | | | Cocoon weight (g) | Shell weight (g) | SR % | Fecundity (nos.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grasserie | Flacherie | Muscardine | Male | Female | Average | | | | |
| Season1 | 54.39cd | 9.97e | 18.50b | 19.25a | 8.67ab | 11.95a | 10.31a | 5.58c | 0.56a | 9.84a | 165.45ab |
| Season2 | 56.80c | 14.83c | 14.48c | 0.35c | 8.47ab | 11.35c | 9.91c | 5.63b | 0.55a | 9.70b | 153.89c |
| Season3 | 63.58a | 6.49f | 19.95a | 0.25c | 9.52a | 11.25c | 10.38a | 5.80a | 0.57a | 9.53c | 167.05a |
| Season4 | 49.25e | 21.50a | 6.38f | 0.00c | 8.91a | 11.67b | 10.29a | 5.46c | 0.52c | 9.52c | 159.87b |
| Season5 | 45.10f | 19.97b | 13.88d | 0.00c | 8.84a | 11.66b | 10.25b | 5.53c | 0.53b | 9.45cd | 160.57b |
| Season6 | 60.50b | 13.66d | 11.03e | 6.75b | 8.53bc | 11.98a | 10.25b | 5.84a | 0.54b | 9.29d | 160.55b |
| S.Ed± | 0.57 | 0.35 | 0.25 | 0.25 | 0.15 | 0.07 | 0.08 | 0.09 | 0.01 | 0.16 | 0.67 |
| CD0.05 | 1.25 | 0.75 | 0.55 | 0.55 | 0.27 | 0.13 | 0.15 | 0.12 | 0.02 | 0.33 | 0.85 |

A figure with common alphabet does not differ significantly

**Table 3. Ranking of different Muga silkworm accessions based on Rearing and Grainage performance and mortality of worms due to diseases during different seasons**

| Accession | ERR (%) | Mortality of worms (%) | | | Larval Body weight(gm) | | | Cocoon weight(gm) | Shell weight (gm) | SR % | Fecundity (nos.) | Total scores | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Grasserie | Flacherie | Muscardine | Male | Female | Avg | | | | | | |
| AC-1 | 0.35 | 0.37 | 0.69 | 0.65 | 0.35 | 0.71 | 0.75 | 0.98 | 0.89 | 0.75 | 0.57 | 7.06 | 5 |
| AC-2 | 0.45 | 0.61 | 0.45 | 0.47 | 0.26 | 0.51 | 0.60 | 0.51 | 0.38 | 0.59 | 0.29 | 5.12 | 2 |
| AC-3 | 0.57 | 0.46 | 0.97 | 0.85 | 0.32 | 0.75 | 0.51 | 0.85 | 0.45 | 0.61 | 0.81 | 7.15 | 6 |
| AC-4 | 0.13 | 0.15 | 0.16 | 0.23 | 0.15 | 0.18 | 0.16 | 0.21 | 0.16 | 0.27 | 0.59 | 2.39 | 1 |
| AC-5 | 0.79 | 0.95 | 0.93 | 0.51 | 0.45 | 0.36 | 0.30 | 0.81 | 0.23 | 0.25 | 0.35 | 5.93 | 3 |
| AC-6 | 0.81 | 0.85 | 1.00 | 0.85 | 0.89 | 0.73 | 0.85 | 0.98 | 0.95 | 0.87 | 0.85 | 9.63 | 7 |
| AC-7 | 0.50 | 0.77 | 0.54 | 0.51 | 0.87 | 0.55 | 0.85 | 0.57 | 0.58 | 0.79 | 0.41 | 6.94 | 4 |

**Study of morphological characters:**

While studying the egg characters for the different Accessions, no variation in colour, shape, presence or absence of streaks on chorion, shape of follicular imprints and muconeum on chorion was observed. The eggs were brown in colour, oval shaped, without any streaks on chorion, muconeum was present. Larval characters like colour of neonate, type of bristles, body colour, haemolymph colour, integument colour, hardly showed any difference for the Accessions. The weight, length and breadth of larva recorded showed wide variations (Table 1a). The neonate was black in colour with yellow streaks, straight bristles, head capsules were dark brown in colour, the mature larvae is light green in colour and integument is black. Range of larval length from first instar to mature larvae was maximum in AC-4 (7.8-88.6 mm) and minimum in AC-6 (7.0-75.9mm).

The colour of pupae is dark brown in all the Accessions. The maximum in male pupal weight was observed in AC-4 (5.7g) and minimum was observed in AC-1 (4.2g). The maximum in female pupal weight was observed in AC-4 (7.1g) and minimum was observed in AC-3 (5.2g). (Table 1c).

No variation among the Accessions was observed in cocoon colour, shape, texture and nature of floss. But significant variations were observed in dry cocoon weight and shell weight in the Accessions. The cocoons were rough textured, golden yellow in colour, elliptical shaped with glossy floss. The maximum cocoon weight was observed in AC-4 (7.26g in female and 4.89g in male). (Table 1b).

While studying the moth characters no significant variations were observed in body colour (except few), ground colour of remigium, ocellus colour. The antennae were bipectinate and red brown in colour. The highest body length was observed in AC-2 (3.1-3.9cm). The largest wing span was observed in AC-2 (15.7cm). (Table 1d).

**Study of the Rearing and Grainage Performance**

Analysis of variance of two years pooled data for different rearing and grainage parameters is presented in Table 2a. Accession no AC-4 was found superior for ERR (effective rate of rearing), Larval Weight, Cocoon weight, shell weight, and fecundity.

Silkworm loss to a great extent is due to outbreak of diseases (Kakati, 2002). The silkworm suffers loss from bacterial (Flacherie), viral (Grasserie) and fungal (Muscardine) diseases (Chaudhury, 1981; Kakati, 2002). In the study conducted for influence of disease in the accessions it was observed that AC-4 showed the highest resistance towards disease.

The rank of the Muga silkworm accessions by the method of Arunachalam and Bandopadhyay (1984) indicated that AC-4 was the best in terms of rearing and grainage performance. The accessions AC-2, AC-5, and AC-7 also indicated superiority over the others.

**Conclusion:**

The germplasm stock collections from different regions and their maintenance in isolation for several generations will help in grouping the stocks based on their performance evaluation. From this study it can be concluded that though there exists little morphological difference among the accessions but there are wide differences in terms of rearing and grainage performance among the accessions. The AC-4 which ranked the best among the accessions, and the accessions AC-2, AC-5 and AC-7 which showed superior behaviour may be included in future breeding programme for evolution of hybrids. Moreover, since, management practices for controlling disease in Muga silkworm culture are found to be ineffective due to outdoor rearing activity, transfer of resistant or tolerant genes is the best alternative. Introduction of such genes in a population may result in many fold increase in cocoon productivity in long run. Search for disease tolerant gene in Muga silkworm may be conducted at molecular level. In this study, AC-4 showed considerable survivality of worms against viral, bacterial and muscardine diseases, which may be considered as base material for future studies.

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